PATENT ABSTRACTS OF JAPAN

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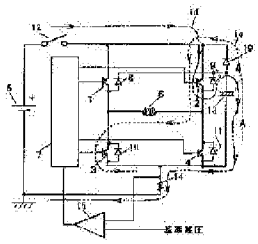
(54) MOTOR DRIVING CIRCUIT



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a driving circuit of a motor which can limit charging current with small number of components and which requires only a small space and can increase the motor efficiency by allowing charging current of an electrolytic capacitor to flow through an upper or a lower arm transistor which constitutes an H-bridge and a resistor for detecting a motor winding current and thereby building up a current limiting circuit with these components.
SOLUTION: When a power switch 12 is turned on, for examle, an upper transistor 2 comes to an ON state and charging current id is caused to flow through the transistor 2 and a diode 9. The current id passes through a resistor 14 for detecting a current, where the current is converted into voltage, and then the voltage is compared with the reference voltage by means of a comparator 15. In the case that current of the set value or above is caused to flow, an output signal from a

logic circuit 7 is cut off to stop the flow of charging current into an electrolytic capacitor 13. When the current in the resistor 14 for detecting a current decreases, the electrolytic capacitor 13 is supplied with charging current again. When charging comes near to completion, a motor winding 5 is also starts to be excited. The sum of the charging current id and the exciting current for the motor winding 5 is kept at the set value.

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CLAIMS

[Claim(s)]
[Claim 1] The current detection resistance which detects the current which flows to motor winding when bipolar energization of the coil of a

motor is carried out with four transistors considered as H bridge configuration, In the motorised circuit which controlled the maximum current which is equipped with the capacitor which absorbs the surge voltage of time of turn of tide, and flows in a circuit The anode of the 1st and 2nd diode is connected with the motor-winding connection terminal of the two upper arm PNP transistor which constitutes the above-mentioned H bridge, respectively. The one terminal [of the above-mentioned capacitor] and anode side of the 3rd diode is connected the cathode side of each diode. The drive circuit of the motor characterized by having connected the cathode side of this 3rd diode to the DC power supply + side, having connected the end of the above-mentioned current detection resistance with the other-end child of the above-mentioned capacitor, and the emitter of the bottom arm NPN transistor of two pieces, and connecting the other end of this current detection resistance to a DC power supply - side.

[Claim 2] The current detection resistance which detects the current which flows to motor winding when bipolar energization of the coil of a motor is carried out with four transistors considered as H bridge configuration, In the motorised circuit which controlled the maximum current which is equipped with the capacitor which absorbs the surge voltage of time of turn of tide, and flows in a circuit The cathode of the 1st and 2nd diode is connected with the motor-winding connection terminal of the bottom arm NPN transistor of two pieces which constitutes the above-mentioned H bridge, respectively. The cathode side of the 3rd diode is connected with one terminal of the above-mentioned capacitor the anode side of each diode. The drive circuit of the motor characterized by having connected the end of the above-mentioned current detection resistance with the emitter of the bottom arm NPN transistor of two pieces, having connected the other end [of this current detection resistance], and anode side of the 3rd diode of the above to the DC power supply - side, and connecting the other-end child of the above-mentioned capacitor to a DC power supply + side.

[Claim 3] The drive circuit of the motor according to claim 1 or 2 characterized by connecting the resistance for charge at the 3rd diode of the above, and juxtaposition.

[Claim 4] The drive circuit of the motor according to claim 3 characterized by using MOSFET and IGBT as a transistor which constitutes the above-mentioned H bridge.

[Claim 5] The drive circuit of the motor according to claim 1, 2, 3, or 4 characterized by the above-mentioned motor being DC brushless motor.

[Claim 6] The drive circuit of the motor according to claim 1, 2, 3, or

4 characterized by the above-mentioned motor being a stepping motor.
[Claim 7] The drive circuit of the motor according to claim 1, 2, 3, or 4 characterized by considering as the three-phase-circuit bridge configuration which the above-mentioned motor is DC brushless motor of a three phase circuit, and has arranged each the transistor energized to motor winding on three vertical arms.
[Claim 8] The drive circuit of the motor according to claim 1, 2, 3, or 4 characterized by considering as the three-phase-circuit bridge configuration which the above-mentioned motor is a stepping motor of a three phase circuit, and has arranged each the transistor energized to motor winding on three vertical arms.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to drive circuits, such as DC brushless motor which controls the drive circuit of a motor, and the charging current which flows in order to charge the electrolytic capacitor for surge absorption in a circuit especially at a power up.
[0002]
[Description of the Prior Art] When carrying out bipolar energization of the DC brushless motor generally, the commutation actuation which changes the direction of energization is needed. The upper arm PNP transistor from which drawing 4 shows the condition of this commutation, and 1 and 2 constitute H bridge, The single phase coil of the motor by which 3 and 4 are the same and a bottom arm NPN transistor and 5 were connected to the output side of the above-mentioned H bridge, It is the energization logical circuit which 7 turns [the DC power supply by

which 6 was similarly connected to the input side, and] on the above-mentioned transistors 1-4, and is turned off. It operates by the signal from energization logic so that the pair of transistors 1 and 4 and the pair of 2 and 3 may be turned on and turned off by turns, and the commutation which the energization direction to motor winding 5 reverses by turns like ia and ie is made to produce.

[0003] In this case, when electrical energy E is accumulated in the single phase coil 5 of the motor which was being energized in a certain direction, and an energization current is set to i and it sets a coil inductance to L, it can express with E=Li2 / 2. When this energization stops, surge voltage Vs arises for a coil terminal by the attenuation degree of a current, and this surge voltage is expressed as Vs=Ldi/dt. There is no emission path of Energy E, and in drawing 4 , in being an instant stop, di/dt becomes infinity, and the very big surge voltage exceeding pressure-proofing of a transistor joins a transistor, and comes to destroy this.

[0004] Therefore, in order to use effectively the energy accumulated in the coil at the same time it protects a transistor from this surge voltage, If the diodes 8-11 for reflux are connected to each transistors 1-4 and juxtaposition as shown in drawing 5 , and the electrolytic capacitor 13 for surge absorption is connected to juxtaposition through a switch 12 at a power source 6 Are recording, now the energy E which is flow through diodes 9 and 10 at the moment of commutation when transistors 1 and 4 flow at and Current ia shifts to an OFF condition in the state of ON as a current ib to motor winding 5. If the electrical potential difference which joins C and an electrolytic capacitor 13 in the capacity of an electrolytic capacitor 13 is set to V, it will come to be accumulated in an electrolytic capacitor 13 as E=valve flow coefficient2 / 2. What is necessary is just to set up capacity so that pressure-proofing of a transistor may not be exceeded since the level of the surge voltage Vs produced in this condition is decided by capacity of an electrolytic capacitor 13, the charging time becomes long, so that capacity is large, and the power surge by surge voltage decreases. Moreover, at the time of energization initiation of hard flow, it will return to motor winding 5 as a current ic via transistors 2 and 3 by using this energy as a power source, the supply current from a power source 6 is reduced, and it becomes an effectiveness rise. In addition, the current detection resistance which detects the current value which energizes 14 to motor winding 5 in drawing 5 , and 15 are comparators which compare the reference voltage equivalent to the set-up maximum current value with a detection electrical potential difference, are

controlling the output of the energization logical circuit 7 with the output of this comparator 15, and restrict the maximum current value produced at the time of motor starting and a lock. The above is the general conventional method of surge voltage absorption.
[0005] However, in the above-mentioned conventional drive circuit, the big charging current according to the capacity and the impedance of a power source flows to an electrolytic capacitor 13 at the power up by the switch 12. Drawing 6 is the wave-like example of the charging current in the electrolytic capacitor capacity of 100 micro F in supply voltage DC24V, and the high current of a maximum of 35 A flows the time for 100 microseconds. This high current affects remarkably the life of the switch for power-source closing motion, a relay, and a semi-conductor. Therefore, like the method which inserts a choke coil 16 in a power source 6 like drawing 7 at a serial in order to restrict the peak value of the charging current, and controls a steep current, or drawing 8 , the resistance 17 for current limiting is inserted in a serial at a power source 6, and the method of making the transistor 18 linked to juxtaposition turn on is in resistance 17 after the completion of charge of an electrolytic capacitor 13.
[0006]
[Problem(s) to be Solved by the Invention] However, in the conventional drive circuit constituted as mentioned above, effectiveness fell with the electrical-potential-difference drop of power-source Rhine, the configuration became large, and many problems that components cost rises are produced.
[0007] With careful attention to the above-mentioned conventional problem, it is the number of components smaller than before for whether your being Haruka, and the purpose of this invention restricts the charging current of an electrolytic capacitor, and its motor efficiency is good and is by space-saving to offer the drive circuit of a low price.
[0008]
[Means for Solving the Problem] The current detection resistance which detects the current which flows to motor winding when the drive circuit of the motor of this invention carries out bipolar energization of the coil of a motor with four transistors considered as H bridge configuration, In the motorised circuit which controlled the maximum current which is equipped with the capacitor which absorbs the surge voltage of time of turn of tide, and flows in a circuit The anode of the 1st and 2nd diode is connected with the motor-winding connection terminal of the two upper arm PNP transistor which constitutes the above-mentioned H bridge, respectively. The one terminal [of the above-

mentioned capacitor] and anode side of the 3rd diode is connected the cathode side of each diode. It is characterized by having connected the cathode side of this 3rd diode to the DC power supply + side, having connected the end of the above-mentioned current detection resistance with the other-end child of the above-mentioned capacitor, and the emitter of the bottom arm NPN transistor of two pieces, and connecting the other end of this current detection resistance to a DC power supply - side.

[0009] Moreover, the current detection resistance which detects the current which flows to motor winding when the drive circuit of the motor of this invention carries out bipolar energization of the coil of a motor with four transistors considered as H bridge configuration, In the motorised circuit which controlled the maximum current which is equipped with the capacitor which absorbs the surge voltage of time of turn of tide, and flows in a circuit The cathode of the 1st and 2nd diode is connected with the motor-winding connection terminal of the bottom arm NPN transistor of two pieces which constitutes the above-mentioned H bridge, respectively. The cathode side of the 3rd diode is connected with one terminal of the above-mentioned capacitor the anode side of each diode. It is characterized by having connected the end of the above-mentioned current detection resistance with the emitter of the bottom arm NPN transistor of two pieces, having connected the other end [of this current detection resistance], and anode side of the 3rd diode of the above to the DC power supply - side, and connecting the other-end child of the above-mentioned capacitor to a DC power supply + side.

[0010] Moreover, in this invention, it is characterized by connecting the resistance for charge with the 3rd diode of the above at juxtaposition.

[0011] Moreover, in this invention, it is characterized by using MOSFET and IGBT as a transistor which constitutes the above-mentioned H bridge.

[0012] It is characterized by considering the above-mentioned motor as the three-phase-circuit bridge configuration which is DC brushless motor or the stepping motor of a three phase circuit, and has arranged each the transistor energized to motor winding on three vertical arms.

[0013]

[Function] In the configuration like ****, the configuration of a current-limiting circuit can be taken by making it go via the resistance for the upper arm transistor which constitutes H bridge for the charging current of an electrolytic capacitor or a bottom arm transistor, and motor-winding current detection, and it can hold down in the same value

as the value of the maximum current of motor winding which had the charging current of an electrolytic capacitor set up.
[0014]
[Embodiment of the Invention] A drawing explains the example of this invention below.
[0015] Drawing 1 is the example which applied this invention to the drive circuit of the bipolar energization method of a single phase DC brushless motor.
[0016] The anode of the 3rd diode 19 is connected with upper arm PNP transistors 1 and 2, the cathode of the 1st and 2nd diode 8 and 9 inserted in juxtaposition, and + electrode of an electrolytic capacitor 13 in this invention. - electrode side of an electrolytic capacitor 13 is connected to the emitter side of bottom arm NPN transistors 3 and 4, and the end of the current detection resistance 14, and the other end of the current detection resistance 14 is connected to - electrode side of DC power supply 6, and the cathode side of the 3rd diode 19 is connected to a DC power supply + side.
[0017] Since the drive circuits of the motor of this invention were the above configurations, when an electric power switch 12 is switched on, In either of the upper arm transistors 1 and 2, and drawing 1 , a transistor 2 will be in ON condition. The charging current id flows via a transistor 2 and diode 9, and the current goes via the current detection resistance 14. When a current is transformed into an electrical potential difference by this resistance, it is compared by reference voltage and the comparator 15 and the current beyond the set point flows, the output signal of a logical circuit 7 is intercepted, the charging current to an electrolytic capacitor 13 is stopped, and if the current which flows the current detection resistance 14 falls, it will come to energize again. Therefore, it becomes possible by performing this actuation at high speed to charge an electrolytic capacitor 13 with the set-up current value.
[0018] Moreover, if charge approaches completion, energization will be started by motor winding 5 and the current of the sum of the charging current id and the energization current of motor winding 5 will come to be suppressed by the set point. When the energy E accumulated in time of turn of tide at motor winding 5 is charged by the electrolytic capacitor 13 via the 1st and 2nd diode 8 or 9 as a current and becomes energization of hard flow, it is returned to motor winding 5 via the 3rd diode 19.
[0019] Drawing 2 shows other examples of this invention which connected the resistance 20 for charge to juxtaposition to the 3rd diode 19, while

the output signal of an energization logical circuit is outputted after an electric power switch injection, as the charging current flows to an electrolytic capacitor 13 through the charge resistance 20, it aims at compaction of the charging time also between time delays, and other actuation is the same as that of the case of drawing 1 .

[0020] Moreover, drawing 3 shows the example of further others of this invention which was made to perform the charge circuit of an electrolytic capacitor 13 by the bottom arm transistor 3 or 4, and the basic actuation is the same as that of the case of drawing 2 .

[0021] Moreover, drawing 9 can show the example applied to the drive circuit of bipolar energization of three-phase-circuit DC brush loess, can constitute a three-phase-circuit bridge circuit from 3, 4, and 32 three upper arm PNP transistor 1, 2, 31, and three bottom arm NPN transistors, and it will be in ON condition any of bottom arm NPN transistors 3, 4, and 32 they are at a power up, it can operate like H bridge component circuit mentioned above, and it can restrict it to the current value which set up the charging current of an electrolytic capacitor 13. In addition, the diode for reflux which connected 33 to a transistor 31 and juxtaposition, and 35-37 are three-phase-circuit motor windings, respectively.

[0022] As mentioned above, although actuation of DC brushless motor of the single phase which applied this invention, and a three phase circuit was explained, there is effectiveness applicable also to the drive circuit of bipolar energization of DC brushless motor of a polyphase or a stepping motor and same. Moreover, although the transistor which constitutes a bridge was used as the bipolar transistor by explanation, the same configuration is possible even if it uses MOSFET and IGBT.

[0023]

[Effect of the Invention] As explained above, according to the drive circuit of the motor of this invention, it has the following outstanding effectiveness.

[0024] (1) It is conventionally realizable for a circuit by the addition of one diode fundamentally.

[0025] (2) Low-pricing and space-saving-ization are realizable.

[0026] (3) There are no components accompanied by power loss in power-source Rhine, and it is efficient for it.

[0027] (4) Time amount from capacitor charge initiation to motor-winding energization initiation is made to the shortest.

[0028] (5) It is applicable to almost all the motorised circuit that carries out bipolar energization.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram showing - example of the drive circuit of the motor of this invention.
[Drawing 2] It is the circuit diagram showing other examples of the drive circuit of the motor of this invention.
[Drawing 3] It is the circuit diagram showing the example of further others of the drive circuit of the motor of this invention.
[Drawing 4] It is the circuit diagram of the bipolar energization without the conventional surge voltage absorption function.
[Drawing 5] It is the circuit diagram of the conventional bipolar energization with a surge voltage absorption function.
[Drawing 6] The charging current wave of the power up of a surge absorbing capacitor is shown.
[Drawing 7] It is the conventional charging current value limit circuit diagram.
[Drawing 8] It is the conventional charging current value limit circuit diagram.
[Drawing 9] It is the circuit diagram showing the example which applied this invention to the drive circuit of a three-phase-circuit DC brushless motor.
[Description of Notations]
1 Upper Arm PNP Transistor
2 Upper Arm PNP Transistor
3 Bottom Arm NPN Transistor
4 Bottom Arm NPN Transistor
5 Single Phase Coil of Motor
6 DC Power Supply

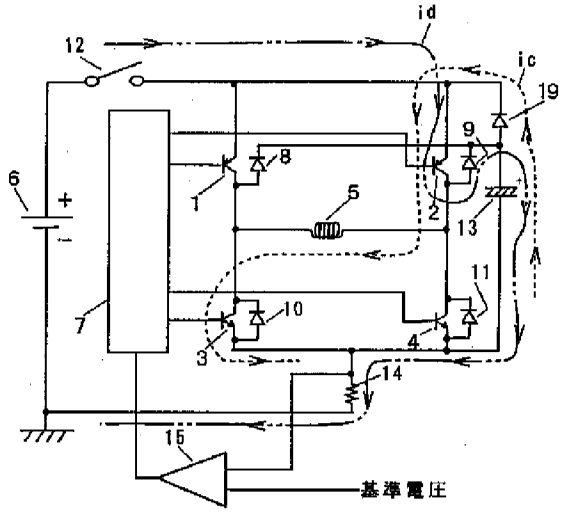
7 Energization Logical Circuit
8 Diode for Reflux
9 Diode for Reflux
10 Diode for Reflux
11 Diode for Reflux
12 Switch for Powering On
13 Electrolytic Capacitor for Surge Absorption
14 Current Detection Resistance
15 Comparator
16 It is Coil Incredibly.
17 Resistance for Current Limiting
18 Transistor
19 Diode
20 Resistance for Charge
31 Upper Arm PNP Transistor
32 Bottom Arm NPN Transistor
33 Diode for Reflux
34 Diode for Reflux
35 Three-Phase-Circuit Motor Winding
36 Three-Phase-Circuit Motor Winding
37 Three-Phase-Circuit Motor Winding

[Translation done.]

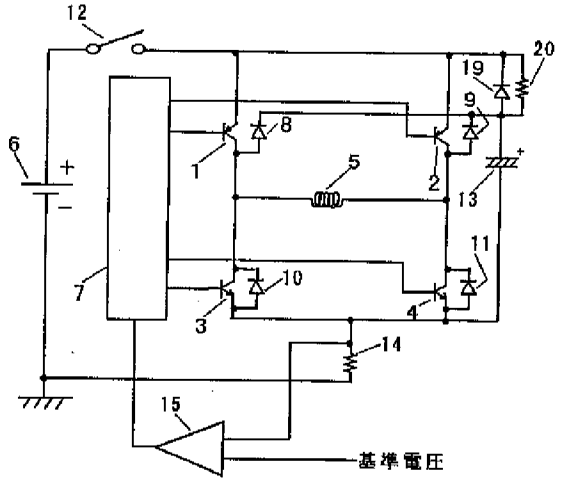
* NOTICES *

DRAWINGS

[Drawing 1]



[Drawing 2]



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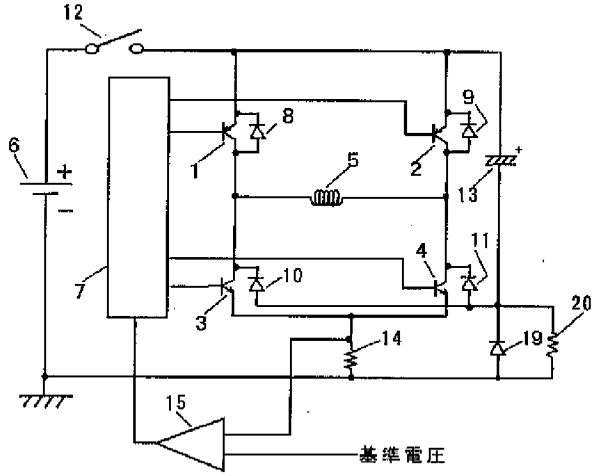

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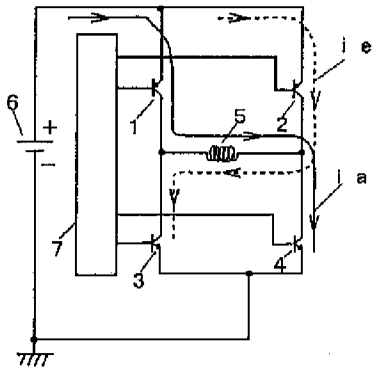

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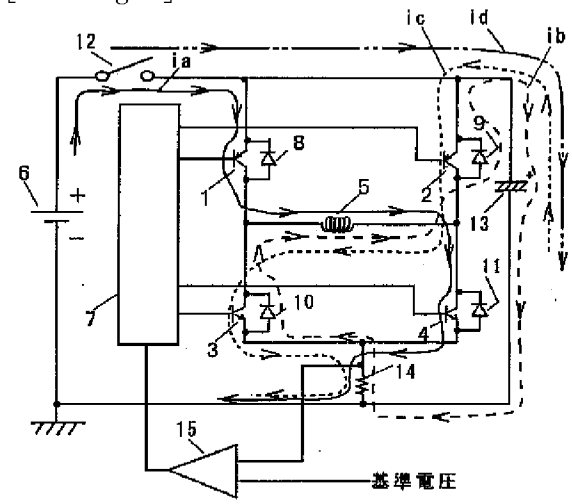

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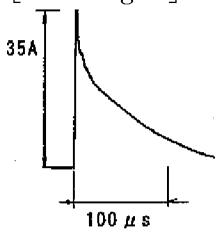
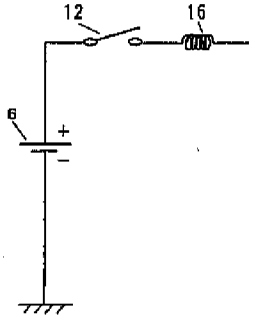
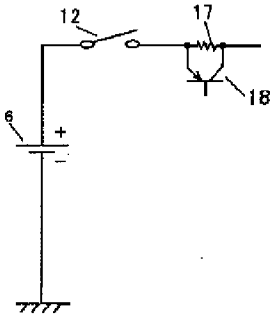


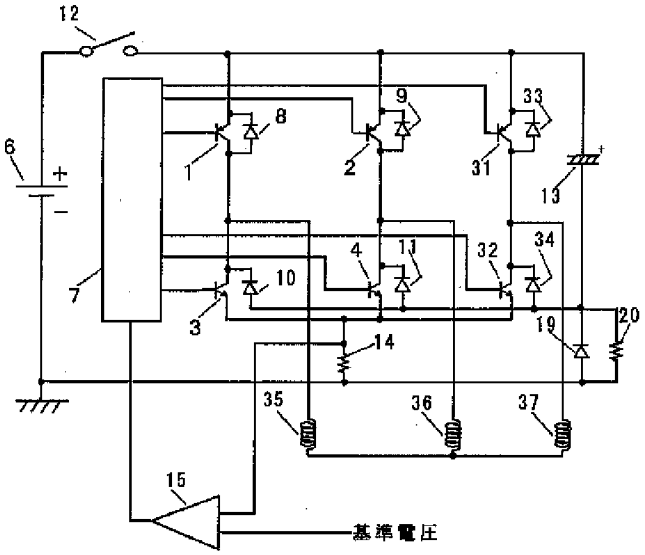
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]

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7/06		7/06	Ｃ

審査請求　未請求　請求項の数８　ＦＤ　（全　６　頁）

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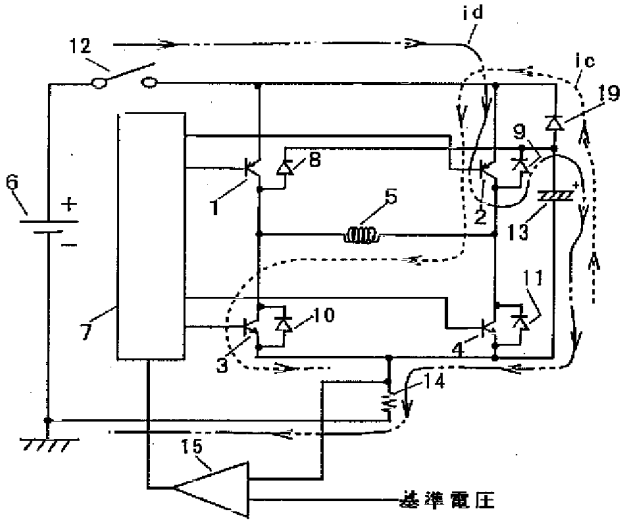
(54)【発明の名称】　モータの駆動回路

(57)【要約】
【課題】　従来、モータのバイポーラ駆動回路に具備されたサージ電圧吸収用コンデンサには電源投入時に大きな充電電流値が流れ、種々の不都合を生ずる欠点があった。
【解決手段】　本発明のモータの駆動回路においてはサージ電圧吸収用の電解コンデンサの充電電流を既存であるＨブリッジを構成する上アームトランジスタ、又は下アームトランジスタとモータ巻線電流検出用の抵抗を経由させることで制限せしめる。



【特許請求の範囲】
【請求項１】　Ｈブリッジ構成とされた４個のトランジスタでモータの巻線をバイポーラ通電したときモータ巻線に流れる電流を検出する電流検出抵抗と、転流時のサージ電圧を吸収するコンデンサとを備え回路に流れる最大電流を抑制するようにしたモータ駆動回路において、上記Ｈブリッジを構成する２個の上アームＰＮＰトランジスタのモータ巻線接続端子と第１，第２のダイオードのアノードを夫々接続し、夫々のダイオードのカソード側と上記コンデンサの一方の端子と第３のダイオードのアノード側を接続し、この第３のダイオードのカソード側をＤＣ電源＋側に接続し、上記コンデンサの他方の端子と２個の下アームＮＰＮトランジスタのエミッタと上記電流検出抵抗の一端を接続し、この電流検出抵抗の他端をＤＣ電源－側に接続したことを特徴とするモータの駆動回路。
【請求項２】　Ｈブリッジ構成とされた４個のトランジスタでモータの巻線をバイポーラ通電したときモータ巻線に流れる電流を検出する電流検出抵抗と、転流時のサージ電圧を吸収するコンデンサとを備え回路に流れる最大電流を抑制するようにしたモータ駆動回路において、上記Ｈブリッジを構成する２個の下アームＮＰＮトランジスタのモータ巻線接続端子と第１，第２のダイオードのカソードを夫々接続し、夫々のダイオードのアノード側と上記コンデンサの一方の端子と第３のダイオードのカソード側を接続し、２個の下アームＮＰＮトランジスタのエミッタと上記電流検出抵抗の一端を接続し、この電流検出抵抗の他端と上記第３のダイオードのアノード側をＤＣ電源－側に接続し、上記コンデンサの他方の端子をＤＣ電源＋側に接続したことを特徴とするモータの駆動回路。
【請求項３】　上記第３のダイオードと並列に充電用抵抗を接続したことを特徴とする請求項１または２記載のモータの駆動回路。
【請求項４】　上記Ｈブリッジを構成するトランジスタとしてＭＯＳＦＥＴ、ＩＧＢＴを使用したことを特徴とする請求項３記載のモータの駆動回路。
【請求項５】　上記モータがＤＣブラシレスモータであることを特徴とする請求項１、２、３または４記載のモータの駆動回路。
【請求項６】　上記モータがステッピングモータであることを特徴とする請求項１、２、３または４記載のモータの駆動回路。
【請求項７】　上記モータが３相のＤＣブラシレスモータであり、モータ巻線に通電するトランジスタを上下アームに各３個配置した３相ブリッジ構成としたことを特徴とする請求項１、２、３または４記載のモータの駆動回路。
【請求項８】　上記モータが３相のステッピングモータであり、モータ巻線に通電するトランジスタを上下アームに各３個配置した３相ブリッジ構成としたことを特徴とする請求項１、２、３または４記載のモータの駆動回路。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明はモータの駆動回路、特に、電源投入時に回路内のサージ吸収用電解コンデンサを充電するために流れる充電電流を抑制するＤＣブラシレスモータ等の駆動回路に関するものである。
【０００２】
【従来の技術】一般にＤＣブラシレスモータをバイポーラ通電する場合、通電の方向を切り替える転流動作が必要となる。図４はこの転流の状態を示すもので１，２はＨブリッジを構成する上アームＰＮＰトランジスタ、３と４は同じく下アームＮＰＮトランジスタ、５は上記Ｈブリッジの出力側に接続されたモータの単相巻線、６は同じく入力側に接続されたＤＣ電源、７は上記トランジスタ１～４をＯＮ，ＯＦＦする通電ロジック回路であって、トランジスタ１と４のペア、２と３のペアを交互にＯＮ，ＯＦＦするように通電ロジックからの信号で動作し、モータ巻線５への通電方向がｉａ，ｉｅのように交互に反転する転流を生ぜしめている。
【０００３】この場合、ある方向に通電されていたモータの単相巻線５には電気エネルギーＥが蓄積され、通電電流をｉ、巻線インダクタンスをＬとするとＥ＝Ｌｉ^2／２で表せる。この通電がストップすると電流の減衰度合いによりサージ電圧Ｖｓが巻線端子に生じ、このサージ電圧はＶｓ＝Ｌｄｉ／ｄｔと表される。図４ではエネルギーＥの放出経路がなく、瞬時ストップの場合にはｄｉ／ｄｔが無限大になり、トランジスタの耐圧を越える非常に大きなサージ電圧がトランジスタに加わりこれを破壊するようになる。
【０００４】従って、このサージ電圧からトランジスタを保護すると同時に、巻線に蓄積されたエネルギーを有効に利用するため、図５に示すように各トランジスタ１～４と並列に還流用のダイオード８～１１を接続し、電源６に並列にスイッチ１２を介してサージ吸収用電解コンデンサ１３を接続すれば、トランジスタ１と４がＯＮ状態では電流ｉａが流れ、ＯＦＦ状態に移行する転流の瞬間にはモータ巻線５に蓄積さているエネルギーＥが電流ｉｂとしてダイオード９と１０を通して流れ、電解コンデンサ１３の容量をＣ、電解コンデンサ１３に加わる電圧をＶとすると、電解コンデンサ１３にＥ＝ＣＶ^2／２として蓄積されるようになる。この状態で生じるサージ電圧Ｖｓのレベルは電解コンデンサ１３の容量で決まり容量が大きいほど充電時間が長くなりサージ電圧による電圧上昇は少なくなるから、トランジスタの耐圧を越えないように容量を設定すれば良い。また、逆方向の通電開始時にはこのエネルギーを電源としてトランジスタ２と３を経由して電流ｉｃとしてモータ巻線５に戻すこ

とになり電源６からの供給電流が低減され効率アップになる。なお、図５において１４はモータ巻線５に通電される電流値を検出する電流検出抵抗、１５は設定された最大電流値に相当する基準電圧と検出電圧を比較するコンパレータであり、このコンパレータ１５の出力で通電ロジック回路７の出力をコントロールすることで、モータ起動時やロック時に生じる最大電流値を制限する。以上がサージ電圧吸収の一般的な従来の方式である。

【０００５】然しながら、上記従来の駆動回路では、スイッチ１２による電源投入時に電解コンデンサ１３に電源の容量とインピーダンスに応じた大きな充電電流が流れる。図６は電源電圧ＤＣ２４Ｖで電解コンデンサ容量１００μＦにおける充電電流の波形の例であり、最大３５Ａの大電流が１００μｓの時間流れる。この大電流は電源開閉用のスイッチ，リレー，半導体の寿命に著しく影響を及ぼす。そのため充電電流のピーク値を制限する目的で図７のように電源６に直列にチョークコイル１６を挿入して急峻な電流を抑制する方式、或いは図８のように電源６に直列に電流制限用の抵抗１７を挿入し、電解コンデンサ１３の充電完了後に抵抗１７に並列に接続したトランジスタ１８をＯＮさせる方法がある。

【０００６】

【発明が解決しようとする課題】然しながら、上記のように構成された従来の駆動回路では、電源ラインの電圧ドロップを伴い効率が低下し、形状が大きくなり、部品コストがアップするという多くの問題を生じている。

【０００７】本発明の目的は上述の従来問題に留意し、従来よりも遙かに少ない部品数で、電解コンデンサの充電電流を制限して、モータ効率が良く、省スペースで低価格の駆動回路を提供するにある。

【０００８】

【課題を解決するための手段】本発明のモータの駆動回路は、Ｈブリッジ構成とされた４個のトランジスタでモータの巻線をバイポーラ通電したときモータ巻線に流れる電流を検出する電流検出抵抗と、転流時のサージ電圧を吸収するコンデンサとを備え回路に流れる最大電流を抑制するようにしたモータ駆動回路において、上記Ｈブリッジを構成する２個の上アームＰＮＰトランジスタのモータ巻線接続端子と第１，第２のダイオードのアノードを夫々接続し、夫々のダイオードのカソード側と上記コンデンサの一方の端子と第３のダイオードのアノード側を接続し、この第３のダイオードのカソード側をＤＣ電源＋側に接続し、上記コンデンサの他方の端子と２個の下アームＮＰＮトランジスタのエミッタと上記電流検出抵抗の一端を接続し、この電流検出抵抗の他端をＤＣ電源－側に接続したことを特徴とする。

【０００９】また、本発明のモータの駆動回路は、Ｈブリッジ構成とされた４個のトランジスタでモータの巻線をバイポーラ通電したときモータ巻線に流れる電流を検出する電流検出抵抗と、転流時のサージ電圧を吸収するコンデンサとを備え回路に流れる最大電流を抑制するようにしたモータ駆動回路において、上記Ｈブリッジを構成する２個の下アームＮＰＮトランジスタのモータ巻線接続端子と第１，第２のダイオードのカソードを夫々接続し、夫々のダイオードのアノード側と上記コンデンサの一方の端子と第３のダイオードのカソード側を接続し、２個の下アームＮＰＮトランジスタのエミッタと上記電流検出抵抗の一端を接続し、この電流検出抵抗の他端と上記第３のダイオードのアノード側をＤＣ電源－側に接続し、上記コンデンサの他方の端子をＤＣ電源＋側に接続したことを特徴とする。

【００１０】また、本発明においては、上記第３のダイオードと並列に充電用抵抗を接続したことを特徴とする。

【００１１】また、本発明においては、上記Ｈブリッジを構成するトランジスタとしてＭＯＳＦＥＴ、ＩＧＢＴを使用したことを特徴とする。

【００１２】上記モータは３相のＤＣブラシレスモータまたはステッピングモータであり、モータ巻線に通電するトランジスタを上下アームに各３個配置した３相ブリッジ構成としたことを特徴とする。

【００１３】

【作用】上述の如き構成においては、電解コンデンサの充電電流をＨブリッジを構成する上アームトランジスタ、または下アームトランジスタとモータ巻線電流検出用の抵抗を経由させることで電流制限回路の構成をとり、電解コンデンサの充電電流を設定されたモータ巻線の最大電流の値と同じ値に抑えこむことが出来る。

【００１４】

【発明の実施の形態】以下図面によって本発明の実施例を説明する。

【００１５】図１は本発明を単相ＤＣブラシレスモータのバイポーラ通電方式の駆動回路に適用した例である。

【００１６】本発明においては、上アームＰＮＰトランジスタ１，２と並列に挿入される第１，第２のダイオード８，９のカソードと電解コンデンサ１３の＋電極と第３のダイオード１９のアノードを接続し、電解コンデンサ１３の－電極側を下アームＮＰＮトランジスタ３，４のエミッタ側及び、電流検出抵抗１４の一端に接続し、電流検出抵抗１４の他端をＤＣ電源６の－電極側に接続し、また、第３のダイオード１９のカソード側をＤＣ電源＋側に接続する。

【００１７】本発明のモータの駆動回路は上記のような構成であるから、電源スイッチ１２を投入した場合、上アームトランジスタ１，２のいずれか一方、図１ではトランジスタ２がＯＮ状態となり、トランジスタ２、ダイオード９を経由して充電電流ｉｄが流れ、その電流は電流検出抵抗１４を経由し、この抵抗で電流が電圧に変換され、基準電圧とコンパレータ１５で比較され、設定値以上の電流が流れたときロジック回路７の出力信号を遮

断し、電解コンデンサ１３への充電電流を停止し、電流検出抵抗１４を流れる電流が低下すると再び通電するようになる。従って、この動作を高速で行なうことで、設定された電流値で電解コンデンサ１３を充電することが可能となる。

【００１８】また、充電が完了に近づくとモータ巻線５にも通電が開始され、充電電流ｉｄとモータ巻線５の通電電流の和の電流が設定値に抑えられるようになる。転流時にモータ巻線５に蓄積されたエネルギーＥは電流として第１，第２のダイオード８又は９を経由して電解コンデンサ１３にチャージされ、逆方向の通電になった際、第３のダイオード１９を経由してモータ巻線５に戻される。

【００１９】図２は第３のダイオード１９に並列に充電用抵抗２０を接続した本発明の他の実施例を示し、電源スイッチ投入後から通電ロジック回路の出力信号が出力される間での遅れ時間の間にも、充電抵抗２０を通して電解コンデンサ１３へ充電電流が流れるようにして充電時間の短縮を図るものであり、その他の動作は図１の場合と同様である。

【００２０】また、図３は電解コンデンサ１３の充電回路を下アームトランジスタ３又は４で行なうようにした本発明の更に他の実施例を示し、その基本動作は図２の場合と同様である。

【００２１】また、図９は３相ＤＣブラシレスのバイポーラ通電の駆動回路に適用した実施例を示し、上アームＰＮＰトランジスタ３個１，２，３１と下アームＮＰＮトランジスタ３個３，４，３２で３相ブリッジ回路を構成し、電源投入時に下アームＮＰＮトランジスタ３，４，３２の何れかがＯＮ状態となり、上述したＨブリッジ構成回路と同様動作を行ない、電解コンデンサ１３の充電電流を設定した電流値に制限することが出来る。なお、３３はトランジスタ３１と並列に接続した還流用ダイオード、３５～３７は夫々３相モータ巻線である。

【００２２】以上、本発明を適用した単相と３相のＤＣブラシレスモータの動作を説明したが、多相のＤＣブラシレスモータやステッピングモータのバイポーラ通電の駆動回路にも適用可能であり同様の効果がある。また、ブリッジを構成するトランジスタを説明ではバイポーラトランジスタとしたが、ＭＯＳＦＥＴやＩＧＢＴを使用しても同様の構成が可能である。

【００２３】

【発明の効果】以上説明したように本発明のモータの駆動回路によれば、次のような優れた効果を有する。

【００２４】（１）基本的には従来回路にダイオード１個の追加で実現可能である。

【００２５】（２）低価格化、省スペース化を実現出来る。

【００２６】（３）電源ラインに電力損失を伴う部品がなく効率が良い。

【００２７】（４）コンデンサ充電開始からモータ巻線通電開始までの時間を最短に出来る。

【００２８】（５）殆どのバイポーラ通電するモータ駆動回路に適用可能である。

【図面の簡単な説明】

【図１】本発明のモータの駆動回路の一実施例を示す回路図である。

【図２】本発明のモータの駆動回路の他の実施例を示す回路図である。

【図３】本発明のモータの駆動回路の更に他の実施例を示す回路図である。

【図４】従来のサージ電圧吸収機能の無いバイポーラ通電の回路図である。

【図５】従来のサージ電圧吸収機能付きバイポーラ通電の回路図である。

【図６】サージ吸収用コンデンサの電源投入時の充電電流波形を示す。

【図７】従来の充電電流値制限回路図である。

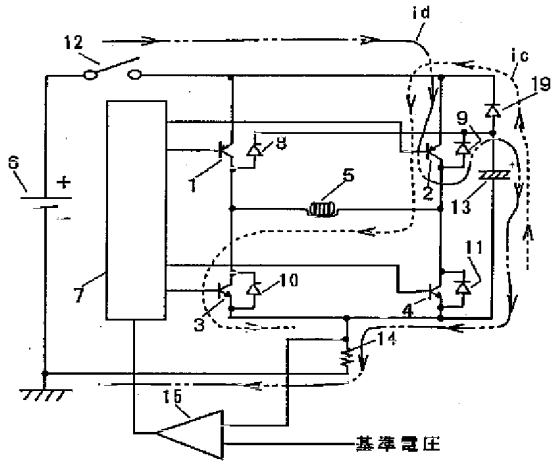
【図８】従来の充電電流値制限回路図である。

【図９】本発明を３相ＤＣブラシレスモータの駆動回路に適用した実施例を示す回路図である。

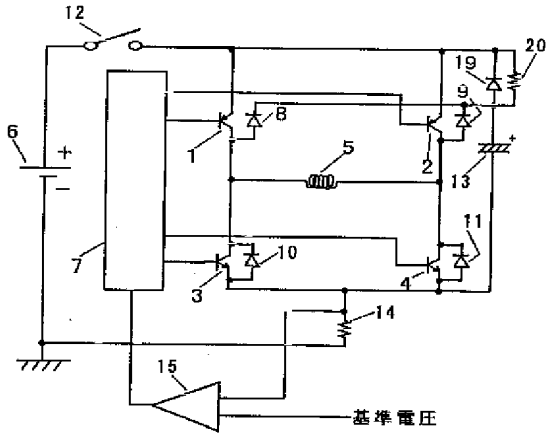
【符号の説明】

１　上アームＰＮＰトランジスタ
２　上アームＰＮＰトランジスタ
３　下アームＮＰＮトランジスタ
４　下アームＮＰＮトランジスタ
５　モータの単相巻線
６　ＤＣ電源
７　通電ロジック回路
８　還流用ダイオード
９　還流用ダイオード
１０　還流用ダイオード
１１　還流用ダイオード
１２　電源投入用スイッチ
１３　サージ吸収用電解コンデンサ
１４　電流検出抵抗
１５　コンパレータ
１６　チョーコイル
１７　電流制限用の抵抗
１８　トランジスタ
１９　ダイオード
２０　充電用抵抗
３１　上アームＰＮＰトランジスタ
３２　下アームＮＰＮトランジスタ
３３　還流用ダイオード
３４　還流用ダイオード
３５　３相モータ巻線
３６　３相モータ巻線
３７　３相モータ巻線

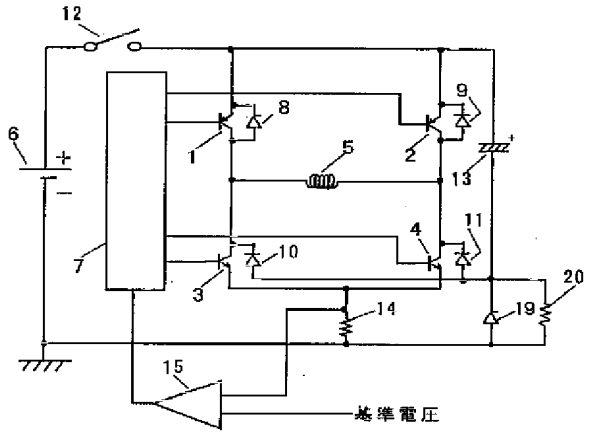
【図１】



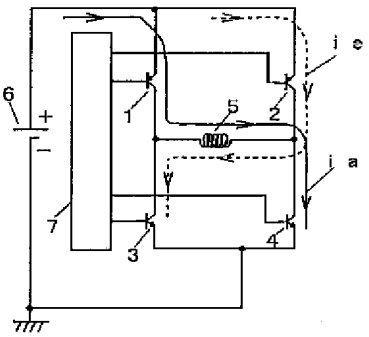
【図２】



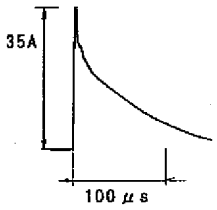
【図３】



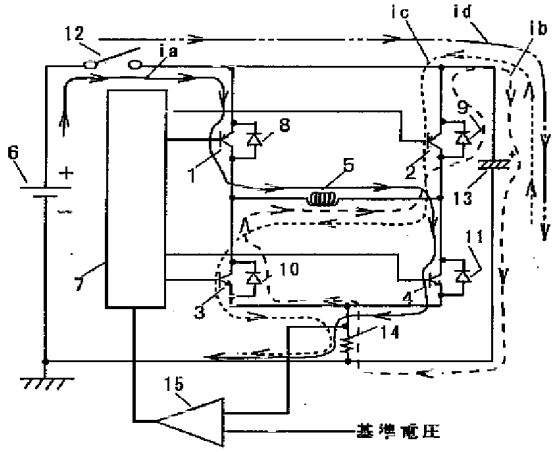
【図４】



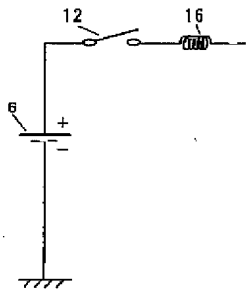
【図６】



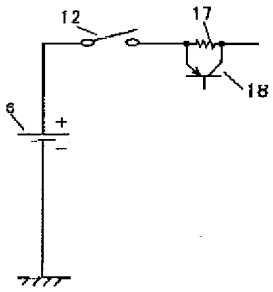
【図５】



【図７】



【図８】



【図９】